THE DIRECTOR'S REPORT

The Arnold Arboretum During the Fiscal Year Ended June 30, 1957

This year marks the eighty-fifth anniversary of the establishment of the Arnold Arboretum. To commemorate this event, special exhibits and open houses have focused attention on the outstanding living collections of trees and shrubs in the Arboretum's plantings both in Jamaica Plain and Weston, as well as on the research collections in Jamaica Plain and Cambridge, while news stories, magazine articles and other types of publicity have dealt with the contributions of the staff members of this organization since its founding in 1872. From its inception, the Arnold Arboretum has played an important role in the introduction of plants new to American gardens from distant parts of the globe. In order to single out some of the plants which members of the Arboretum staff have introduced into cultivation in America, Mr. Heman Howard, the assistant horticulturist, prepared special wooden labels painted yellow to be attached to the proper plants. A survey of the records was made to locate those plants or their descendants now growing in the Arboretum which had been introduced into American horticulture for the first time at Jamaica Plain; about 1800 yellow tags were required to label those plants in immediate view from the roads and paths. Such plants proved to be of immense interest to the many visitors of the past season. They saw that some of the most common and the most sought-after varieties were first introduced into American gardens by the Arnold Arboretum.

The Staff:

At the fiftieth anniversary banquet of the Botanical Society of America the president of the Society presented Certificates of Merit to fifty distinguished botanists for their contributions to their fields. Two staff members of the Arnold Arboretum, Irving Widmer Bailey and Karl Sax, were among those so honored. Their citations were:

"Irving Widmer Bailey, Plant anatomist and inspiring teacher, for his outstanding contributions on the structure of the cell wall and the histology of the cambium, and for his application of anatomy and morphology to problems of evolution of angiosperms."

"Karl Sax, for his classical studies on the chromosomes of wheat, his continued interest in the chromosomes of ornamental woody plants and his extensive contributions about the effect of irradiation on chromosome breakage and chromosome structure."

The presentations were made at the University of Connecticut during the annual meeting of the American Institute of Biological Sciences.

Two staff members, Drs. Sax and Howard, were invited to serve as American Institute of Biological Sciences lecturers to stimulate interest in a biological career among students in smaller liberal arts colleges. This program

places outstanding scientists, teachers and lecturers on the campus of the college for several days. The speaker has the opportunity of meeting with students, staff and the public formally in lectures and informally about the campus and in the dining halls. Dr. Sax was able to visit the College of Wooster, in Ohio, and Dickinson College at Carlisle, Pennsylvania, for this program during the year. The association has proved to be stimulating and the program is being continued.

The demand for Arboretum staff members as speakers exceeds our abilities to fill all requests. During the year staff members attended conferences or gave lectures in seventeen states and in Canada. Dr. Sax took part in symposia on "Biological Effects of Ionizing Radiation" at Storrs, Connecticut, on "Population" at the University of Minnesota, on the hazards of ionizing radiation at the Canadian Atomic Energy Commission meetings at Chalk River, Canada, and on Forest Tree Physiology at the Harvard Forest. Dr. Howard talked to many horticultural organizations and other groups on the Arnold Arboretum, emergency survival problems, his research in plant taxonomy and on the vegetation of the West Indies. On one trip he met with garden clubs and botany departments of universities in Tennessee, Georgia, Louisiana and Texas. Dr. Wyman attended horticultural meetings in Delaware and Michigan and spoke at the Williamsburg symposium and at the Longwood Gardens. Mr. Coggeshall represented the Arboretum at the Propagators Convention in Cleveland and nearly all of the staff attended the annual meetings of the American Institute of Biological Sciences at Storrs, Connecticut.

During the year Dr. Sax was elected an honorary member of the Japanese Genetics Society and his appointment as consultant in biology to the Oak Ridge National Laboratories was renewed.

One annual appointment was made to the staff for work on the Flora of the Southeastern States and three for work on the herbarium integration and general curatorial duties. Dr. Charles W. James joined our staff after an appointment at the University of Tennessee and Dr. Frances M. Jarrett came to the Arboretum at the completion of her graduate work at Cambridge University, Cambridge, England. Dr. Jarrett is a specialist in the flora of the Malaysian area. Mrs. Jeanne Germaine Weber, who has been working on the flora of Europe at the Botanical Garden in Geneva, Switzerland, will assist in the herbarium integration. Dr. Howard F. L. Rock completed his graduate work at Duke University and, having specialized in the Compositae, has been working on the reorganization of that large family of flowering plants. With the exception of that of Miss Jarrett, these appointments were made jointly with the Gray Herbarium.

Horticulture:

One of the functions of the Arnold Arboretum is the growing of plants hardy in the vicinity of West Roxbury. Regardless of staff efforts, the ultimate success of the trees and shrubs planted in Jamaica Plain seems to be controlled by the weather. In past years, hurricanes, summer heat or flooding, late frosts, ice storms or other vagaries of the climate have had

their effect on the growth of the plants in our collection. This past winter was marked by a period of unusually cold weather. A four-night period of sub-zero weather climaxed by a low temperature of twelve degrees below zero was recorded at the greenhouses on January 15 and lower temperatures were probably experienced elsewhere on the grounds. At Weston the temperature dropped to thirty degrees below zero on the same day. Many of the plants considered marginally hardy were killed outright, killed to the ground or severely injured during this cold weather. These have been listed and the injuries discussed in two issues of ARNOLDIA during recent months. Some of the recent introductions, particularly among the rhododendrons growing in the nurseries at Weston, died during the winter. The spring flowering of many genera and species was also affected by the cold weather, for flower-buds formed last summer were killed during the period of low temperatures, except where snow accumulation or other forms of fortuitous or deliberate protection were present. With the exception of the *Forsythia* 'Beatrix Farrand,' most selections of *Forsythia* were in poor flower. The flowering cherries and the early azaleas were likewise disappointing in bloom, with the protective effect of snow-line strongly marked. In contrast, or perhaps in reality, other groups such as the lilacs, the crab apples, the Ghent and flame azaleas and the rhododendrons seemed to have extremely profuse bloom. Specimens of some trees, such as *Cladrastis lutea*, carried unusually heavy bloom, while others, as the dove tree (*Davidia involucrata*), failed to produce a single flower.

The Park Department of the City of Boston, through the cooperation of Commissioner Frank Kelley and his assistants, Mr. O'Keefe and Mr. Byrne, continued its work of rehabilitation on the grounds of the Arboretum. During the year sections of the roads and sidewalks were patched, benches painted and repaired and, with the assistance of the Arboretum staff, all of the cobblestone gutters except those in the Peter's Hill tract, have now been dug out and cleaned. The appearance of the paths and roads has been materially improved by this work.

The Arboretum staff has under way work on the collections and the grounds which adds to the appearance of the Arnold Arboretum plants and plantings. Twenty-five large truckloads of well-screened and composted leaf mould were distributed around the shrubs. The spent hops which have been used as a mulch for a number of years are no longer available and the use of ground cocoa shells has been started on an experimental basis. Early reports of this material as a mulch have been published in ARNOLDIA. Test plots using various applications of the cocoa shell have been established on the grounds of the Case Estates in Weston. While the cocoa shell will not burn, as did some other mulches tried at the Arboretum, there are certain disadvantages to the new mulch which must be evaluated before final acceptance of this material.

A section of native woodland adjacent to our collection of dwarf conifers was cleared during the winter and work has begun on transplanting some of the smaller plants in this collection. It is hoped to extend the collection

toward the road, thus giving individual plants more room and displaying them to greater advantage.

Over twenty varieties of narcissus and daffodils have been planted along Bussey Brook near the rhododendron collection to establish a naturalized display a few years hence. Some of the collection bloomed well this spring. The bed of *Calluna* nearby was reduced in size. For a number of years we have attempted to maintain and replace where needed a large number of named varieties, many of which have died in cold winters, even with protection. It now seems desirable to limit our plantings to the cultivars which have proved hardy.

Several additional vistas have been opened up at the top of Bussey Hill and ground-covers have been established there. The ground-covers selected for this much-visited spot were those of the larger collection in Weston which have been most attractive to visitors.

Some work was done by the Park Department in partial repair of the retaining wall along Bussey Brook behind the rhododendron collection. On the steep slopes of Hemlock Hill near the rhododendron collection additional hurricane debris and damaged trees were removed. A new planting of rhododendron species has been started in this cleared area. If the present test planting of forty specimens thrives, as is expected, additional areas will be cleared and developed into a new and attractive display for the Arboretum.

A saran-cloth house 104 × 16 feet was erected near the greenhouse to replace the badly broken lath shade structure which had been used for many years. This is a temporary expedient until the threatened eminent domain procedures against the greenhouse area are clarified.

Planting in the Jamaica Plain collections has been difficult due to the continued dry weather of late spring and early summer. In all, three hundred specimens of twenty-two species and varieties of evergreens and one hundred thirty-five deciduous species have been added to our collections during the fall and spring plantings. These are either new plants or replacements for defective specimens. All have required continuous watering and care.

Approximately one hundred seventy-five species and varieties have been introduced from foreign countries during the year. These plants apparently are not available from commercial sources or other gardens in this country. After testing and observation at Weston they will be planted in Jamaica Plain.

Dr. Wyman, the horticulturist, in cooperation with the U. S. Department of Agriculture and other arboreta, arranged for the introduction of twenty-six kinds of evergreens and twenty-nine varieties of deciduous plants which are normally prohibited entry into this country. These plants will be grown at Glen Dale, Maryland, for the quarantine period and then released when judged free of insect and disease pests. The Arnold Arboretum, which manages this program, has been responsible for assisting other gardens in introducing about one hundred varieties of plants in this program during the year.

Requests for plant materials from the living collections of the Arboretum included pollen for breeding programs and reference collections, samples of leaves and stems for chemical analysis, soil samples from roots of specific trees for chemical and antibiotic tests, herbarium specimens and propagating material. During the past fiscal year two hundred forty-nine shipments of propagating materials were sent out, representing eight hundred sixty species and varieties. The majority of these went to arboreta and botanic gardens within the United States and Canada. However, requests received from twelve countries in Europe, Asia, Africa and Australia were filled. Only thirty-seven shipments of one hundred fifty-two species and varieties were of seeds. This indicates the increasing demand for material for vegetative propagation in the horticultural interest.

Eight plants were grown in quantity and distributed to thirty-three cooperating commercial growers in North America for eventual distribution through sale to the general public. These new or selected species, hybrids or clones, considered by the staff to be of significant horticultural value, were *Acer capillipes*, *Acer rufinerve*, *Carpinus japonica*, *Lonicera amoena rosea*, *Malus* 'Henrietta Crosby', *Malus* 'Henry F. du Pont', *Malus* 'Mary Potter' and *Syringa* × *swegiflexa*.

During the past year the Arnold Arboretum received one hundred ninety-one shipments, representing six hundred ninety species and varieties, as seeds, propagating material or plants. These were included in the 1102 species and varieties handled by the propagation department during the year. Not all of the seeds proved viable, nor did all the propagating material for rooting, budding and grafting prove useful.

The development of proper techniques in propagating and handling the rare and unusual plants in the living collections is important to the extended acceptance and use of these plants. Many of the most interesting plants introduced by the Arboretum have never had wide use because of difficulties in propagating or transplanting the species. Much of the experimental work in the greenhouses by the propagator and other staff members concerns various aspects of this basic problem. Some of the work which has been done in the last year concerned species of *Abies*, *Acer*, *Davidia*, *Fagus*, *Picea*, *Pinus*, *Tilia* and *Stewartia* and varieties of *Syringa vulgaris*.

Experimental work was tried to overcome the double dormancy of seeds of *Davidia involucrata* by exposing the seeds to warm temperatures followed by cold temperatures prior to planting. Seeds were collected from the ripe fruits, mixed with moistened sand and peat and placed in polyethylene bags. The bags were then stored at greenhouse temperature, from 60 to 85 degrees, for six months and then kept in a refrigerator for three months at 40 to 42 degrees. When planted immediately afterward, a germination of from 65 to 70 percent was obtained within three weeks.

Selected varieties of *Syringa vulgaris* were tested to compare the effect of different hormone concentrations on rooting and the resulting rates of growth between these rooted cuttings and grafted plants. Results indicated that if the softwood cuttings are taken early in May and treated

with Hormodin No. 3 for maximum rooting, such plants will produce growth equal to that of scions grafted during the year.

Attempts were also made to graft varieties of *Syringa vulgaris* in the fall, storing such grafts through the winter to obtain more rapid growth during the following spring. Such experiments were not successful. The grafts callused normally in one month in sawdust and were stored in plastic bags in a refrigerator. Abnormal or no growth was obtained the following year.

Various species of *Tilia* were propagated from softwood cuttings taken in August. Again good rooting was obtained, but unexplained difficulty was encountered in overwintering such rooted plants. Previously, the same difficulty was experienced when *Stewartia* cuttings taken in August were rooted. Experiments of the past years have shown that cuttings of the latter plant taken in June and treated with Hormodin No. 3 rooted well. When these were potted and stored in a cold pit for the winter, normal recovery and growth was experienced the following year.

Normally, the lack of space in the greenhouse and nursery area necessitates the transplanting of young plants from two to five times before they are large enough for permanent planting in the Arboretum. Many plants survive such treatment, but certain others suffer extremely heavy losses in the course of the many transplantings. In the last few years we have attempted to reduce these losses by the use of metal containers which can be moved about without disturbing the root systems while the plants increase in size. Thus young seedlings of *Davidia*, rooted cuttings of *Stewartia* and grafted plants of *Abies*, *Fagus*, *Picea* and *Pinus* have been handled with a minimum of loss and the elimination of an average of three transplanting operations.

The Case Estates:

Shortly after the Arboretum was given the property known as the Case Estates in Weston, the town felt the need for additional land for new school buildings. In 1946 a tract of forty-two acres was sold to the town of Weston from the Case Estates for a modest sum. As the town has grown, however, the need for additional school buildings and adjacent playground space has increased. During the past year a study committee, termed the School Site Committee, returned a recommendation that the future growth of the school population be met by a decentralized school building program. The committee's report containing the negative vote of a single member was supported by the selectmen and other town officials. Nevertheless, at a town meeting held in the fall the committee's report was not accepted and the town meeting voted to take by eminent domain the land of the Case Estates north and west of a 500-foot line parallel to Wellesley Street. Although the town officials have taken no further action during the past fiscal year, a School Building Committee and a firm of surveyors have given consideration to building three additional schools on land to be taken from the Case Estates. Such action could involve seventy

or more acres of the one hundred forty-five acres now in the Case Estates, leaving less than half of the land originally given to the Arboretum for horticultural purposes in Weston. The director has indicated to the selectmen of the town that the Arboretum does not wish to lose this land and that such a loss will seriously restrict future development of the Arnold Arboretum. Nevertheless, much time has been spent with appraisers and surveyors during the past year and considerable staff planning has been necessary to determine what plants can be moved and what others should be propagated if the land-taking proceedings are carried out.

The collections at the Case Estates such as the ground-cover demonstration plots, the small-tree demonstration area and the shrub and perennial gardens are being visited by an ever-increasing number of people. Garden clubs have requested special trips and tours of these plots and plantings. A new pruning demonstration tract has been established this year and will show results next spring. Comparison tests on the use of cocoa shell as a mulch are also being conducted at Weston. Repairs were completed on the Chandler house which was turned over to the Arboretum last year and which is now occupied by the Director of the Arnold Arboretum.

Education Program:

During the third year of the informal education program for adults conducted at the Arnold Arboretum, the spring and fall field classes with Dr. Wyman and the propagation classes with Mr. Coggeshall were continued and were well attended. Again this year the applications for the classes in plant propagation exceeded the physical limits of the greenhouse and some people had to be disappointed. Dr. Wood offered a class in identification of cultivated plants and Dr. Howard taught two new classes in economic botany entitled "Botany in Boston I and II." The former dealt with the commercial utilization of plant materials in industry and greenhouses in the Boston area and the second concerned the use of plant materials as foods in various Boston restaurants. During the spring the staff combined to present a series of seminars on cultivated plants which were open to the public as one of the regularly scheduled classes. At each seminar Dr. Howard discussed the history and botanical classification of the group, Dr. Wyman the horticultural utilization and values, Dr. Sax the genetics and breeding programs, Mr. Williams the diseases and maintenance and Mr. Coggeshall the methods of propagation. Each seminar was scheduled to be held when the plant group under discussion was in flower on the grounds. When the weather permitted, visits were made to the collections of lilacs, magnolias and forsythias, crab-apples, cherries and rhododendrons before the seminar discussion. The interest of the class members was high in this concentrated presentation of information regarding restricted groups of ornamental plants. During the three years of the education program which has been conducted at the Arboretum, four hundred and eighty-eight people have attended one or more courses.

All staff members were needed to assist when the Arboretum cooperated

with the Massachusetts Horticultural Society in presenting their annual Field Day in Jamaica Plain. Eight buses were filled for the two-hour trip around the grounds; other visitors followed in their own cars. A staff member served as a guide in each bus and attempted to answer the many questions which were asked. In addition to this regularly scheduled event, many garden clubs now hold meetings at the Arboretum where staff members conduct the groups through the grounds. Special tours have been arranged for children's groups, older people and the handicapped.

Exhibits and displays:

The Arboretum display at the Massachusetts Horticultural Society's Spring Flower Show held in Mechanics Building emphasized the eighty-fifth anniversary of the Arnold Arboretum by featuring a planting of ornamental trees and shrubs introduced by the Arboretum staff. The featured plants numbered about forty of the over 5000 species and varieties for which the Arboretum receives credit. These ranged from a red-leaved variety of the Japanese barberry, introduced in 1879, to the dawn redwood, *Metasequoia*, introduced as seed in 1948. Plants developed at the Arboretum or selected from progeny grown for testing included *Forsythia* 'Beatrix Farrand' and *Prunus* 'Hally Jolivette' developed by Dr. Sax, the crab-apple 'Dorothea' and the bush-honeysuckle 'Arnold Red'. The exhibit received a first prize from the Massachusetts Horticultural Society and was awarded the gold medal of the Pennsylvania Horticultural Society for "an exhibit of special merit which stimulates an interest in horticulture." The latter is one of the two top awards offered at this show.

A Christmas show was held at the Administration Building in Jamaica Plain and featured plant material used in Christmas decorations, such as tree ornaments, wreath-making materials and broad-leaved evergreens used in floral arrangements. Mrs. Donald Wyman created several wreaths and arrangements showing the steps in preparation of such decorations which proved to be a feature of the exhibit. This was held from December 4 to 21, 1956 and was enthusiastically attended.

A selection of fifteen plants from the Larz Anderson Collection of Japanese Dwarf trees was sent to Detroit for display in the March Spring Flower Show in that city. These proved to be an interesting feature of the Michigan show and received a great deal of comment.

Open houses were held on May 12 at the Case Estates in Weston, on May 19 at Jamaica Plain and on June 10 in Cambridge. Staff members, identified by badges, were on the grounds and in the buildings at each location to answer questions or explain work in progress. The interest expressed by the many visitors proved stimulating to all.

Library:

The librarian, Mrs. Lazella Schwarten, and her staff continued the work on the integration of the Arnold and Gray libraries and the reconditioning

of books in addition to the regular service of an active library. During the preceding year the integration of the periodicals had been completed; work continued this year on the other categories, so that the total task is now over half finished. Additional stacks were constructed for volumes dealing with the horticultural subjects in Jamaica Plain and a further reorganization is under way on the latter collection.

During the year two hundred and twenty-nine bound volumes were added to the library, bringing the total of bound volumes to 49,738. Two hundred and fifty pamphlets were received and added to the collection, which now contains 16,218 items. Among the various catalogues maintained, 580 cards were added to the general card file and 4000 to the Gray Herbarium Index.

The requests for interlibrary loans from outside organizations continues to mount and, of necessity, certain procedures have been incorporated into our operations. Except in very special cases, books over one hundred years old or those currently available on the commercial market are not sent on loan. Even within these limits, the librarian may restrict the privilege of a loan depending on the condition, value and local need for the book. Wherever possible, microfilm, photocopy or a typed description of the material needed is suggested as a substitute for a loan. Nevertheless, ninety-five books were sent out during the year on interlibrary loan. The use of the library by staff and students increased measurably during the year as work in other parts of the Arboretum increased.

Herbarium:

The work concerned with the integration of the two major collections housed in the Harvard University Herbarium in Cambridge involved most of the efforts of the herbarium staff again this year. The plans for progress in this essential task have been discussed in previous reports. During the past year it was possible to appoint additional taxonomists to the staff to assist with this work. Special funds were made available by the Harvard Corporation for this project. Such funds have been used to employ full-time workers as well as some part-time help. During the year the operation of placing in sequence all genera of the various families in the collections was completed. At this time the family sequence is complete and all of the genera are in proper order. Actual integration at the specific level has progressed so that one hundred sixty families or about one-half of the herbarium is in final arrangement. During the course of this work, which is under the direction of Dr. Kobuski, annotations are made according to the latest monographs available, geographical arrangements are coordinated, repairs to specimens are made where possible and types and other authentic specimens are indicated and placed in special folders. The completed portions of the herbarium stand as a model for future work.

The fruit and seed collections received special care during the year and this collection is now uniformly boxed, adequately spaced, and completely rearranged. The sequence used follows that of the herbarium.

Curatorial work on the herbarium of cultivated plants at Jamaica Plain was limited, but the task of checking the coverage continued. Additional collections of cultivated plants from the United States and Europe were inserted.

During the past year 6,874 specimens were mounted and inserted in the herbarium, bringing the total accession count to 694,681 specimens in the Arnold Arboretum.

The herbarium received 17,157 specimens during the year. About 10,900 of these were in exchange, 5,900 were from collectors subsidized by the Arboretum and the remainder as gifts or for identification. The largest number of these came again this year from Malaysia. Of the total 5,400 represented the flora of the New World, 1,900 that of Europe and the remainder that of Asia, Africa and Australia. The largest and most important Asiatic collections were received from Canberra, Australia; the Rijksherbarium, Leiden, the Netherlands; the Royal Botanic Garden at Kew, England; and the Herbarium Bogoriense, in Indonesia. The materials received by subsidy were largely photographs of type-specimens in European herbaria made by the New York Botanical Garden.

During the year the Arnold Arboretum sent out 878 specimens to American institutions and 665 to foreign institutions in a regular continuation of exchange. In addition, a special shipment of 2613 specimens was sent to the Forestry Department at Lae, New Guinea, representing a complete set of the plants collected by L. J. Brass on the Fourth Archbold Expedition. Three hundred and eighty-six specimens of this same collection were sent to specialists for identification.

Again the facilities of the herbarium were made available to many visitors and additional materials were sent on loan or services rendered in response to requests by mail or phone. During the year 10,421 herbarium specimens were sent out from the combined herbaria on loan to qualified scholars. These represented seventy-eight separate loans to forty-five different institutions and averaged over one hundred thirty specimens per loan. Fifty of the loans were to twenty-eight American institutions, while twenty-eight loans went to seventeen different foreign herbaria. The size of these loans is indicative of the wealth of material in the Harvard herbaria and the need for these same materials for comprehensive research programs. In addition to these requests, the staff, where possible, answered questions concerning identifications, distributions or technical problems which could be handled more reasonably by our staff than by the shipment of specimens.

Most of the research interests of the staff continue at present as mentioned in the previous annual report.

Comparative Morphology:

Professor I. W. Bailey, Professor of Plant Anatomy, *emeritus*, has continued to serve as curator of the wood and pollen-slide collections. Professor Bailey's services materially assist the herbarium staff and assure

the maintenance of the collections in good condition. A small number of accessions of wood samples and slides were added to the collection during the year and the requests for specimens from these collections continued at a normal rate.

Professor Bailey completed several papers on wood anatomy and the use of anatomical characters in other aspects of botanical study. His recent interests have turned to the anatomical structure of the stem in the Cactaceae.

Cytogenetics:

Dr. Karl Sax, his assistants and students have reported the following contributions in the field of cytogenetics:

The cytogenetic work with *Malus sargentii* continues and now shows that this species is both facultatively apomictic and tetraploid. *Malus sargentii* var. *rosea*, however, is a triploid. When the species is crossed with diploids the sexual progeny are usually triploids. When the variety is crossed with diploids the progeny range from near diploid to approximately tetraploid. In most of the crosses made, facultative apomixis is inherited as a dominant trait.

New hybrids of *Malus*, *Forsythia*, and *Magnolia* species are being propagated for further testing. Induced polyploidy and the induction of mutations by ionizing radiation continue to be used in an attempt to create new ornamental plants.

The work on dwarfing techniques for fruit and ornamental trees and shrubs now shows that knots tied in the stems of apple seedlings curtail growth but do not cause earlier flowering as they do in the case of vegetatively propagated clonal varieties. Further experiments with bark inversions have shown that following bark removal the freshly exposed wood can be induced to form new bark by covering the exposed surface with either polyethylene film or with a non-toxic grease such as lanolin. These techniques should be of value in treating injured trees.

Instruction:

Three staff members offered four regularly scheduled classes within the college and the graduate schools during the year. Dr. Johnston taught his course in the "Phylogeny and Classification of the Flowering Plants" and Dr. Sax gave "Plant Cytology with special reference to Genetics and Taxonomy." Dr. Howard offered two new courses. "Plant Materials" was offered as Landscape Architecture 7–1a in the fall semester and was taught at the Arboretum. During the spring semester a second course, "Principles and Problems of Horticultural Taxonomy," open to undergraduates in the college, was offered through the Department of Biology. The latter course included lectures in Cambridge as well as field and laboratory work on the grounds of the Arboretum in Jamaica Plain as the spring season progressed.

Mr. Tchang Bok Lee, a UNKRA Fellow from Korea, completed the re-

quirements for the degree of Master of Arts under the direction of Dr. Howard and was awarded the degree at the mid-year commencement. Mr. Lee undertook a research program of hybridizing Korean and North American oaks and returned to Korea with seeds of these hybrids for trial. Mr. Lee also spent considerable time reviewing recent forestry literature and checking collections and distributions of trees and shrubs from Korea in the herbaria of the Arnold Arboretum and the Gray Herbarium. Mr. Claud Brown continued his graduate research on pine hybrids with Dr. Sax.

Regularly scheduled seminars on problems of plant taxonomy and plant geography were held in the Harvard University Herbarium during the year. Arboretum staff members took part in these non-credit programs open to undergraduate and graduate students.

Travel and Exploration:

Staff members of the Arboretum did not personally engage in any extensive program of field work during the past year. Small grants from special funds were made to support the work of collectors in foreign countries and to obtain material of value to the work of the Arboretum staff or specimens desired for our collections. Such grants enabled us to obtain seeds of additional ornamental woody plants from Japan, Scotland and Sweden. Herbarium specimens of authentically identified cultivated woody shrubs were obtained from several European gardens by extending nominal financial support.

Miss Lily Perry was granted a leave of absence during the spring to study at several European herbaria. This work was made possible by a grant several years ago to Dr. E. D. Merrill, which was known as the E. D. Merrill Discretionary Fund. It was Dr. Merrill's request that the residue of this fund at the time of his death be made available for Dr. Perry's use and that she use it to further the studies they had begun cooperatively on the flora of New Guinea. Miss Perry has been able to study at the British Museum, Natural History Department and the Royal Botanic Gardens at Kew. Later she will spend some time at Leiden and Utrecht in Holland.

Gifts and Grants:

In this period of continuing inflation there is a great need for gifts for the general operation of the Arnold Arboretum. Happily, the Friends of the Arnold Arboretum have increased in number and in many cases the gifts have also increased in size. During the past fiscal year the Trustees of the Arnold Arboretum, the President and Fellows of Harvard College, increased the book value of the Arboretum endowment funds entrusted to their care. This resulted in an increase in the restricted and unrestricted income from endowment and, in part, met the general increase in wages as well as the increased cost of supplies and materials of the past year. A

bequest from the estate of Mrs. Clement Houghton was also added to the endowment.

Gifts for cultural purposes from the Friends of the Arnold Arboretum during the year were used to employ summer labor for care of the living collections on the grounds of the Arboretum at Jamaica Plain and Weston. These funds were also used to supply an assistant in the field of cytogenetics to work with Dr. Sax and an assistant in the greenhouse to help the propagator, Mr. Coggeshall.

The staff has been encouraged to apply to government agencies, private foundations and industry for grants to support research where applicable. A renewed grant from the Atomic Energy Commission was awarded to Dr. Sax for his work on the conduction of materials through the plant and for work on chromosome breakage patterns. Dr. Howard received an award from the National Science Foundation for two years to support morphological work on the vascular pattern of petioles in flowering plants. In both of these cases the awards enabled the recipients to employ technicians to do work which, if carried on otherwise, would have had to be supported by unrestricted funds from the Arboretum endowment. The necessity for such applications and grants will probably increase in the future. Currently only one Arboretum staff member has a research assistant paid from Arboretum funds.

Mr. George Cooley has renewed his support through gifts for taxonomic work under the joint direction of Dr. Rollins, Director of the Gray Herbarium, and Dr. Howard. This special fund has been used to further work on the wild and cultivated vegetation of the southeastern United States leading towards a generic flora of that area.

Publications:

During the past fiscal year the usual twelve numbers of ARNOLDIA were published with Dr. Wyman as editor and four issues of the JOURNAL OF THE ARNOLD ARBORETUM with Dr. Kobuski as editor. There were no special publications during the year.

Bibliography of the Published Writings of the Staff and Students

July 1, 1956 — June 30, 1957

BAILEY, IRVING WIDMER. Nodal anatomy in retrospect. Jour. Arnold Arb. **37:** 269–387. 1956.

——— The relationship between Sphenostemon of New Caledonia and Nouhuysia of New Guinea. Jour. Arnold Arb. **37:** 360–365. 1956.

——— (with ABRAHAM FAHN). The nodal anatomy and the primary vascular cylinder of the Calycanthaceae. Jour. Arnold Arb. **38:** 107–117, *pl. 1, 2.* 1957.

CHANNELL, ROBERT BENNIE. Reappraisal of two plumose Rhynchosporas of the southeastern United States. Rhodora **48:** 335–343. 1956.

——— A revisional study of the genus Marshallia (Compositae). Contr. Gray Herb. **181:** 1–132. 1957.

COGGESHALL, ROGER GIBBS. The Propagation of Asiatic Maples. Amer. Nurseryman **105:** 9–10, 96–99. 1957.

DICKSON, A. G. (with E. W. SAMUELS). The mechanism of controlled growth of dwarf apple trees. Jour. Arnold Arb. **37:** 307–313. 1956.

FAULL, JOSEPH HORACE. A rust of Woodwardia fimbriata. Jour. Arnold Arb. **37:** 314–316. 1956.

HOWARD, RICHARD ALDEN. Coccoloba. *In*: Supplement Royal Hort. Soc. Dictionary Gardening, page 183. 1956.

——— The Director's Report. The Arnold Arboretum during the fiscal year ended June 30, 1956. Jour. Arnold Arb. **37:** 375–402. 1956.

——— Elmer Drew Merrill 1876–1956. Jour. Arnold Arb. **37:** 197–213, *portrait*. 1956.

——— The Palm Society. Amer. Assoc. Bot. Gardens & Arb. **28:** 3, 4. 1956.

——— Studies of the genus Coccoloba, II. The identification of Coccoloba swartzii Meisner and Coccoloba barbadensis Jacquin and their relatives. Jour. Arnold Arb. **37:** 317–339. 1956.

——— Studies in the genus Coccoloba, III. The Jamaican species. Jour. Arnold Arb. **38:** 81–106. 1956.

——— (with GEORGE R. PROCTOR). Studies of the vegetation on bauxite soils in Jamaica. Nat. Hist. Notes (Jamaica) **7**(73): 3–8. Jl 1955 (Jl 1956).

——— The vegetation on bauxite soils in Jamaica. Jour. Arnold Arb. **38:** 1–41, *pl. 1–9*. 1957.

——— Vegetation on bauxite soils in Jamaica, II. Jour. Arnold Arb. **38:** 151–169. 1957.

HU, SHIU-YING. Climbing the trails of the Giant Panda. Appalachia **22:** 164–172. 1956.

JAMES, CHARLES W. A new variety of Stipulicida setacea. Rhodora **59:** 98. 1957.

——— Notes on the cleistogamous species of Polygala in southeastern United States. Rhodora **59:** 51–56. 1957.

——— A revision of Rhexia (Melastomataceae). Brittonia **8:** 201–230. 1956.

JOHNSTON, IVAN M. Studies in the Boraginaceae, XXVIII. New or otherwise interesting species from America and Asia. Jour. Arnold Arb. **37:** 288–306. 1956.

KOBUSKI, CLARENCE E. A new species of Ternstroemia from Jamaica, B.W.I. Rhodora **59:** 36–38. 1957.

——— Studies in the Theaceae, XXIX. Further studies in the genus Melchiora. Jour. Arnold Arb. **38:** 199–204, *pl. 1–4*. 1957.

——— Theaceae. *In*: Steyermark, Julian A. et al. Contributions to the Flora of Venezuela. Fieldiana. Bot. **28:** 980–982. 1957.

SAX, KARL. Chromosome Botany (Review). Science **688:** 124. 1956.

——— The Population Explosion. Headline Series, Foreign Policy Assoc. No. 120, p. 3–61. 1956.

——— (with A. G. DICKSON). Phloem polarity in bark regeneration. Jour. Arnold Arb. **37:** 173–179. 1956.

SCHWARTEN, LAZELLA. Bibliography (Howard, R. A.; *Elmer Drew Merrill*) Jour. Arnold Arb. **37:** 213–216. 1956.

——— Index to American Botanical Literature. Bull. Torrey Bot. Club **83:** 315–325, 391–401, 443–456, 1956; **84:** 59–68, 141–150, 219–228. 1957.

Wood, Carroll E., Jr. Some cultivated relatives of the Camellia. Arnoldia **17:** 1–12, *pl. 1–4.* 1957.

Wyman, Donald. Acer platanoides "Crimson King" vs. "Fassen's Black." Arnoldia **16:** 52. 1956.

——— Crab apples for ornamental fruits. Arnoldia **16:** 29–32. 1956.

——— The ground cover demonstration plots (Brought up to date). Arnoldia **16:** 53–59, *pl. 14, 15.* 1956.

——— The hedge demonstration plot — Twenty years after planting. Arnoldia **17:** 17–32, *pl. 6–8.* 1957.

——— Hedges for North America. Nat. Hort. Mag. **36:** 204–217. 1957.

——— Mulching practices at the Arnold Arboretum. Plants & Gardens **12:** 27–30. 1957.

——— New and rare ornamental woody plants recently distributed by the Arnold Arboretum. Arnoldia **16:** 33–52, *pl. 9–13.* 1956.

——— Small trees for today's gardens. Horticulture **35:** 77, 100–101. 1957.

——— Something new has been added — Cocoa-shell mulch. Arnoldia **17:** 33–36, *pl. 9.* 1957.

——— Whence came our shrubs and trees. Horticulture **35:** 312–313, 338–339. 1957.

——— Winter injury — 1957. Arnoldia **17:** 13–16, *pl. 5.* 1957.

——— (with Florence Wyman). Christmas decorations from woody plant material. Arnoldia **16:** 61–72, *p. 16–21.* 1956.